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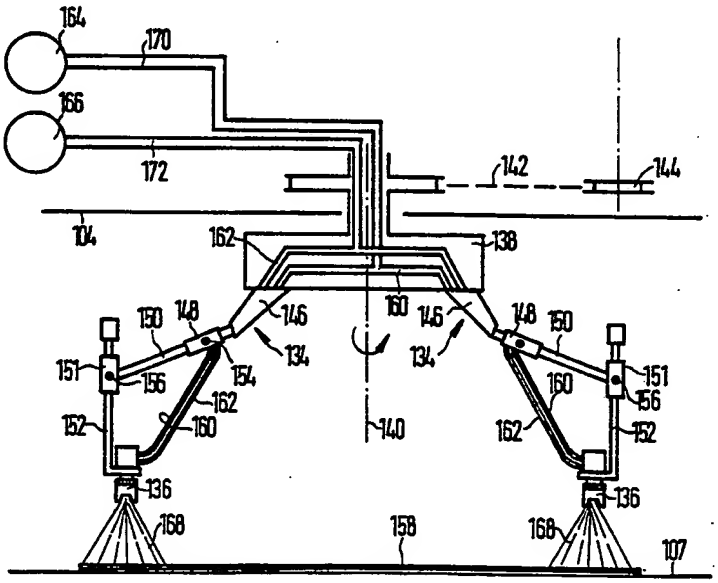

(57) Abstract

Surface sheets (230) impregnated with thermosetting resin and including a layer of abrasion-resistant particles are produced by the disclosed process. The process includes a method of applying the abrasion-resistant particles by spraying a slurry of such particles onto the surface of a web (158) by means of a rotary head (138) and a plurality of spray pistols (136). The step of spraying the slurry onto the surface of the web occurs after a first impregnation and may be followed by a second resin coating step.

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IMPROVED METHOD AND APPARATUS FOR PRODUCING HIGH ABRASION RESISTANCE SURFACE SHEETS, AND SHEETS PRODUCED THEREBY

TECHNICAL FIELD OF THE INVENTION

The present invention relates in general to impregnated laminates, and more particularly to a method and apparatus for applying abrasion-resistant particles to a surface sheet used in such laminates, and surface sheets produced thereby.

BACKGROUND OF THE INVENTION

Laminated materials, such as those formed of paper and impregnated melamine-formaldehyde resins and the like, find uses as surfacing materials in countertops, table tops, walls and the like. These laminates typically consist of a stack of several impregnated paper webs. A top or surface sheet of the stacked laminate most often contains a pleasing design and/or color. It is desirable to impart abrasion resistance to this top sheet so that it will not be worn away to expose the undecorative kraft paper laminations underneath it.

One way to impart abrasion resistance to the top or surface sheet is to coat or otherwise apply abrasion-resistant particles to the sheet. The particles can, for example, be any of several hard minerals such as alumina or silica. Several methods are known in the art to accomplish this. U.S. Patent No. 4,940,503 issued to Lindgren et al. illustrates a method of applying small, dry, hard particles directly on to the surface of a wet impregnated paper web through a doctor-roll. In another known process, abrasion-resistant particulate matter such as alumina is applied electrostatically to a wet, impregnated web and the web then dried. In a third prior art process, exemplified by U.S. Patent No. 4,263,081 issued to Scher et al., hard particulate matter such as alumina is deposited on the surface of a dry web using a binder such as microcrystalline cellulose. The web is then dried and subsequently impregnated with a thermosetting resin. U.S. Patent No. 4,505,974 issued to Hosler, which patent is fully incorporated herein by reference, discloses spraying a coated mineral

dispersion onto dry, melamine-formaldehyde resin impregnated decorative sheets.

These prior art methods of applying an abrasion-resistant layer have various drawbacks. When the alumina is simply dropped or electrostatically adhered to a wet web, an unsatisfactorily uneven distribution of alumina results. Further, merely dropping the alumina onto the wet web does not sufficiently firmly adhere the alumina thereto.

The use of microcrystalline cellulose as a binder has drawbacks when particular visual effects, such as pearlescent or opalescent effects, are desired. The highly refractive nature of microcrystalline cellulose defeats this visual characteristic. Further, according to certain prior art processes, the application of the grit at an early stage causes increased wear on the web rollers because of the presence of abrasive particles. The need therefore exists in the industry for an improved method and apparatus for applying abrasion-resistant particles to a surface sheet web.

SUMMARY OF THE INVENTION

According to one aspect of the invention, a method for manufacturing abrasion-resistant surface sheets for laminates includes the steps of impregnating the web with a thermosetting resin; prior to drying the web, spraying the impregnated web with a slurry including abrasion-resistant materials; thereafter drying the impregnated web; and cutting the web into sheets of predetermined length.

In a preferred embodiment, the step of spraying the slurry of abrasion-resistant materials is performed by a rotary head which is disposed above the impregnated web. A preselected number of spray arms are affixed to the rotary head so as to radially and downwardly extend from the rotary head. A spray pistol is mounted on a remote end of each of the spray arms. A pressurized air pipeline and a slurry pipeline are connected to each of the spray pistols. As the web passes underneath the rotary head, the rotary head rotates and the spray pistols spray a slurry of abrasion-resistant particles onto the surface of the web. This provides a more uniform coverage than has heretofore been obtained with such methods as dropping dry particles onto a web or electrostatic adherence.

According to a further aspect of the invention, a station for partially drying the web occurs immediately after the spray station. Then, a coating of thermosetting resin is applied to the partially dried web at a coating station placed after the first drying station. The web is then further dried in a second drying station. The dried web is then cut into surface sheets.

Top sheets produced by the invention have a paper web impregnated with a thermosetting resin selecting from the group consisting of melamine-formaldehyde, phenol-formaldehyde, phenol-urea-formaldehyde, melamine-urea-formaldehyde, urea-formaldehyde and polyester, and having a resin content between 30 and 80% by weight. The abrasion-resistant particles are sprayed onto the upper surface of the web before drying at a concentration of 1 to 40 grams per square meter. The particles preferably have a size falling within a Gaussian distribution centered around 9 microns, and are selected from the group consisting of alumina, silica, silicon carbide, boron nitride, diamond and mixtures of the foregoing. The use of abrasion-resistant particles of this size provides good abrasion resistance, but does not detract from a pearlescent or opalescent effect contributed by the design of the top sheet.

The present invention provides several technical advantages. The claimed method can be put into practice by merely incorporating the slurry-spraying step into a conventional laminate-producing installation. This allows existing equipment to be used. Applying the abrasion-resistant material through spraying allows the process to be highly controlled and to be controlled independently from the initial impregnation step. Cylinders which come into contact with the impregnated web prior to the abrasion-resistant particle application step do not experience any wear from such particles, which tend to be abrasive themselves. The method and apparatus of the invention also avoid the use of special papers.

BRIEF DESCRIPTION OF THE DRAWINGS

Further aspects of the invention and their advantages will be discerned with reference to the following detailed description when taken in conjunction with the drawings, in which like characters identify like components and in which:

FIGURE 1 is a schematic diagram of a process for fabricating abrasion-resistant surface sheets, diagrammatically illustrating several successive steps in the process;

FIGURE 2 is a detail of FIGURE 1 showing the beginning stages of the process;

FIGURE 3 is a schematic elevational view of a rotary spray head according to the invention; and

FIGURE 4 is an elevational sectional detail of a slurry spray pistol according to the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring first to FIGURE 1, a schematic representation of apparatus for the continuous manufacture of abrasion-resistant surface sheets is shown including a plurality of stations at which different process steps are performed. At point 100, a continuous paper web is fed into the process. The paper does not require any special characteristic with respect to the later application of the abrasion-resistant material. The paper will typically have a decorative printed design or the like, as is suitable for a top or surface sheet of a laminate. The web is fed through the various process stations by use of standard conveying equipment (only schematically shown).

At station 101, a first impregnation of the paper web occurs. The impregnation is performed in a conventional manner. The impregnation may be carried out with a vessel or bath of melamine-formaldehyde, phenol-formaldehyde, phenol-urea-formaldehyde, melamine-urea-formaldehyde, urea-formaldehyde or polyester, with a resin content of 30 to 80% and preferably between 40 and 60% by weight. Preferably, the first impregnation step at station 101 is performed using a drip-and-squeeze process with a resin bath having a viscosity in the range of 20 to 100 centipoises, and with squeeze rollers 103.

The impregnated web 102 next passes to a station 104, which includes an enclosed cabin or compartment 106. The web 102 is carried in a flat condition by a conveyor belt 107 or the like (see FIGURES 2 and 3). Inside cabin 106, a slurry of hard particulate matter is sprayed onto the surface of the web 102 using pressurized air. The slurry is formed through

a continuous agitation of abrasive particles, water and/or adequate solvents or binders as well as a dispersion/suspension agent. The dispersion/suspension agent can be a polyacrylic acid or the like. The dispersion agent prevents the grit from settling down and keeps it dispersed in the slurry. The slurry contains an abrasive particle weight in the range of 5 to 40%. The slurry should have a final viscosity range in between 5 and 80 seconds No. 4 Ford cup (10-200 centipoises), and more preferably, between 10 and 30 seconds (15-100 centipoises). The surface of the paper web 102 is sprayed until it is uniformly covered with a weight of 1 to 40 grams per square meter and, more preferably, between 2 and 20 grams per square meter. The abrasive particles can be constituted by any of several materials, such as alumina, silica, silicon carbide, boron nitride, diamond or a mixture of any of the above.

The particle size affects the characteristics of the finished laminate surface in that the greater the particle size, the greater the abrasion resistance. A particle size between 1 and 100 microns, and preferably between 2 and 50 microns, is regarded as most adequate. In a particularly preferred embodiment, a particle size having a Gaussian distribution around 9 microns is used.

One advantage of the invention is that because the particle slurry is directly sprayed onto the wet impregnated web 102, no microcrystalline cellulose or other binder is necessary. However, where a binder is desired, any can be used as long as it is compatible with the impregnation resin applied to the web at station 101. For a melamine-formaldehyde resin, binders such as modified caseins, acrylic compounds,

polyvinyl alcohols, et cetera can be used in binder:grit weight ratios ranging from 1:5 to 1:15.

In the instance where the design definition calls for a pearlescent or opalescent effect in the final surface sheet, the grit size should be large enough so as not to detract from it. A grit size having a Gaussian distribution around 9 microns has been found not to detract from the visual characteristics of the finished surface sheet. Microcrystalline cellulose should be avoided for use with pearlescent top sheets as its highly refractive nature interfers with the visual effect. The average thickness of the abrasive particle coating on the web 102 is in the range of 1 to 8 microns.

The beginning steps of the process are illustrated in more detail in FIGURE 2. From a drum 110, a continuous paper web 112 is fed via rollers 114 between a photocell 116 and a light source 118. Photocell 116 and light source 118 coact such that when the end of the web 112 is reached, the photocell 116 will be activated. Photocell 116 is connected by a relay or the like (not shown) to each of a plurality of valves mounted in respective spray pistols of the slurry sprayer 108, all of which will be described below: Web 112 is then guided by rollers 120, 122, 124, 126, 128 and 130 through a vat or both 132 of melamine formaldehyde resin or other impregnation resin. After impregnation is completed by passage of the web 112 through the squeeze rollers 103, the impregnated web 102 passes into the spray cabin 106.

A novel rotary sprayer indicated generally at 108 includes a plurality of spray arms indicated schematically at 134, each arm 134

terminating in a spray pistol 136. The arms 134 are connected to a rotary spray head 138 which is driven to rotate about its axis indicated by the dashed line 140. The rotary spray head 138 may, for example, be belt-driven by an apparatus such as a drive belt indicated schematically at 142 and an electric motor indicated schematically at 144. The electric motor 144 has a speed variator which is coupled to the general motor (not shown) of the apparatus 10. This general motor regulates the speed of the paper web 112 so as to synchronize rotation speed of the head 138 and of the paper in the apparatus 10.

The rotary sprayer 108 and associated equipment are illustrated in more detail in FIGURE 3. In FIGURE 3, two spray arms 134 are shown instead of the three arms 134 that are shown in FIGURE 2. The number of spray arms may be varied according to the application. The spray arms 134 are radially displaced from the axis 140 and are angularly disposed around the circumference of the spray head 138 preferably to be equally separated from each other.

Each spray arm 134 includes an arm segment 146 which is directly affixed to the spray head 138. The arm segment 146 distally terminates in an adjustment sleeve 148. A second arm segment 150 has a first proximal end fitted into the adjustment sleeve 148 and a second distal end terminating in a sprayer carrier holder 151. The adjustment sleeve 148 includes fasteners for adjustably holding the arm segment 150 in place, such as a screw or screws 154 or the like. A spray carrier 152 is fitted into the carrier holder 151. The carrier holder 151 likewise is an adjustment fitting, and includes a screw or screws 156 or the like. Carrier holder 151 allows

the distance from the pistol 136 to the web being treated 158 to be adjusted.

Each sprayer carrier 152 terminates in at least one spray pistol 136. Through adjusting the arm segment 150 with respect to the first arm segment 146 using the sleeve 148, the radial distance of the pistol 136 from the axis 140 can be adjusted. The radial arms 134 are adjusted in order to take into account the differing widths of the impregnated web 158 which might be treated, which for example may range from 1240 to 1700 mm.

Each spray pistol 136 receives pressurized air in a respective air pipeline 160 and liquid slurry in a respective slurry pipeline 162. Air and slurry pipelines 160 and 162 are preferably sized to be at least 5 mm. in interior diameter.

The air inside air pipe 160 is compressed, as by a compressor schematically illustrated at 164, to a pressure in a range of 2 to 10 kg/cm^2 in order to impart suitable spraying force to the slurry emitting from pistols 136, with a preferred working range of 2 to 3 kg/cm^2. A slurry pump schematically illustrated at 166 may be used to provide slurry under pressure to pipes 162. A slurry feed pressure in the range of 1.5 to 4 kg/cm^2 has been found suitable for operating the spray pistols 136, with a preferred slurry pressure of 1.5 to 2 kg/cm^2.

The spray pistols 136 each produce a conical spray or haze 168 which is sprayed onto the surface of the impregnated web 158. It is preferred that a single pipe or a line 170 be used to convey the pressurized air into the spray head 138, at which point air pipe 170 branches into a plurality of pipes or lines 160. Similarly, a single pipe 172 carries the pressurized slurry from the slurry pump 166 into the rotary head 138,

where it branches into a plurality of slurry pipelines 162 equal in number to the number of spray pistols 136.

FIGURE 4 is a detailed elevational sectional view of a single spray pistol 136. A body 174 of the pistol 136 has formed therein a central bore 176 which is formed around a pistol axis 178. The bore 176 has a tapered lower orifice 180. Received into the bore 176 is a needle 182 having a frusto-conical end surface 184 adaptable to seat on the tapered surface of orifice 180. The elongate needle 182 extends into a top portion 186 of the pistol 136 having relatively thin sidewalls 188. Sidewalls 188 define a lower chamber 190 and an upper chamber 192. A spring 194 is operable to exert force between a needle flange 196, affixed to needle 182, and a pistol cap 198. The cap 198 includes a central bore 200 adaptable to slidably receive a top end 202 of the needle 182 when the needle 182 is in an upward or open position.

The flange 196 slides in close registry with the sidewalls 188 of top portion 186. A sealing gasket or ring 204 allows a coaxial up-and-down sliding motion of the needle 182, but nevertheless substantially hermetically separates the lower chamber 190 from the bore 176.

The air pipe 160 branches into a first length 206 regulated by a remotely controlled valve 208, and a second branch 212. Extending from the remotely controlled valve 208 to the lower chamber 190 is a pipe segment 210. When the valve 208 is open, pressurized air from pipe 160 flows into the lower chamber 190, urging the needle flange 188 in an upward direction against the bias exerted by the spring 194. The upward urging of the needle 182 will cause frustoconical surface 184 to unseat itself

from the tapered surface of orifice 180, causing sloped orifice 180 to open. Separately, branch 212 communicates the air pipe 160 with an annular outlet 214. Air flowing out of the outlet 214 imparts downward spray force to the slurry.

The slurry is fed by slurry pipe 162, and enters into bore 176 and out through the orifice 180. When air ceases to flow through pipe 160, or when the remotely controlled valve 208 is turned off, the spring 194 forces the needle 182 into registry with the sloped walls of the orifice 180, thus cutting off the spraying of slurry from pipe 162.

Remotely controlled valve 208 preferably is controlled by the photocell 116 (FIGURE 2). When the photocell 116 senses that the end of the web 112 has passed it, it will cut off the spraying of slurry from each of the pistols 136 by closing the respective remotely controlled valves 208. The cap 198 may be removed for servicing of the spray pistol interior.

Returning to FIGURE 1, once the web 158 has been sprayed to deposit a layer of hard particulate matter, the web 158 is passed to a first drying oven station 216. Once the web 158 has partially dried in the oven 216, it is preferably passed to a coating station 218 at which a second coating of melamine or other thermosetting resin is applied to the surface of the web. It is preferred that this be performed by a roller-coating operation as indicated by roller 220. The melamine or other thermosetting resin used at station 218 can have a viscosity in the range of 30 to 300 centipoises.

The additional coating provides the surface of the web with various special characteristics as desired. Along with a second resin, other

additives may be added to the web at this point, such as finer abrasive particles, pearlescent pigments, and other materials.

After the roller coating step, a web 222 is produced which is passed to a second drying stage or oven 224. The dried web 226 is subsequently passed to a cutting stage 228 at which the web 226 is cut into surface sheets 230 having a desired length. These may be subsequently used in a laminating process to create laminates for use in countertops, walls, partitions and the like. The surface sheets 230 may be subjected to laminating temperatures and pressures that are normally used in higher pressure laminates, such as a temperature in the range of 120 to 160° C., depending upon the type of resin used, and pressure of 70 to 120 kilograms per square centimeter.

The present invention provides several technical advantages. It may be put into practice by merely incorporating the innovative spray step shown at 104 into an installation having otherwise conventional process steps. The abrasive coating is applied in a direct and very controllable fashion in a step which is independent from the initial dip-and-squeeze impregnation which takes place at step 101. The squeeze cylinders 103 do not suffer from abrasion due to abrasive particles, as the abrasive slurry is sprayed onto the surface of the web only after excess resin is squeezed out of the web in the first impregnation step. This, in turn, reduces the number of failures and increases the lifetime of the process equipment. The present invention also avoids the use of special papers where abrasion resistance is desired. Because of the spray method used, there is no need for a binder such as microcrystalline cellulose. The lack of such a binder, which has a

tendency to be highly refractive, allows the surface sheet to take on any other variety of different visual characteristics, including pearlescence or opalescence.

The surface sheets 230 finally produced are therefore based on a web that is first impregnated with a first resin at a dip-and-squeeze 101. Subsequently, a layer of abrasion-resistant particles is applied to the web at station 104. In a preferred embodiment, the web is completed with the application of a second thermosetting resin, which may be the same or different from the resin initially applied at step 101. This allows additional materials to be placed on the surface of the surface sheet, such as finely divided abrasive particles and the like.

In summary, a novel method and apparatus for spraying a particulate slurry of abrasion-resistant particles onto an impregnated web, and a novel surface sheet produced thereby, have been disclosed in the above detailed description. However, the present invention is not limited to the specific embodiments of the invention but only by the scope and spirit of the claims which follow.

I CLAIM:

1. Apparatus for applying an abrasion-resistant particulate material to a web to be used as a top sheet in a laminate, comprising:

a rotary head having an axis, motive power means coupled to said rotary head to rotate said rotary head about said axis;

a conveyor spaced underneath said rotary head for conveying a web thereunder;

a plurality of spray arms, first ends of said spray arms affixed to said rotary head to be spaced apart from each other, second ends of said spray arms disposed remotely from said rotary head axis;

for each spray arm, a pistol mounted on said second end, each said pistol adaptable to spray air-pressurized slurry onto said web;

for each pistol, a pressurized air pipeline having a first end connected to said pistol for introducing pressurized air therein and a second end remote from said first end in communication with a source of pressurized air; and

for each pistol, a slurry pipeline having a first end connected to said pistol for introducing slurry therein and a second end remote from said first end in communication with a source of a liquid slurry of abrasion-resistant particles, said rotary head operable to rotate about its axis while said pistols are spraying air-pressurized slurry onto said web to provide an even distribution of said particles on said web.

2. The apparatus of Claim 1, wherein each of said spray arms includes radial adjustment means for adjusting the radial distance between said axis of said rotary head and a respective pistol.

3. The apparatus of Claim 1, wherein each spray arm includes means for adjusting the vertical position of the pistol affixed to said spray arm with respect to said web.

4. Apparatus for manufacturing abrasion-resistant top sheets for use in impregnated laminates, comprising:

a source of continuous paper web;

an impregnation station placed after said source and operable to receive said web to impregnate said web with thermosetting resin;

a spray station placed after said impregnation station and operable to receive said impregnated web, said spray station including means for spraying a slurry of abrasion-resistant particles onto said impregnated web;

at least one drying station placed after said spray station and operable to at least partially dry said sprayed, impregnated web; and

a cutting station placed after said drying station and operable to cut said web into top sheets.

5. The apparatus of Claim 4, wherein said spray station further comprises a conveyor for supporting and moving said web in a flat condition, said means for spraying including a rotary sprayer spaced from

said web and having an axis of rotation forming an angle to said web, a plurality of spray pistols of said sprayer displaced radially from said axis and angularly displaced from each other, a source of abrasion-resistant particle slurry connected to each of said spray pistols, a source of pressurized air connected to each of said spray pistols, said spray pistols operable to rotate about said axis and at the same time to spray said slurry onto said web to effect a uniform distribution of said particles onto said web.

6. The apparatus of Claim 4, wherein said at least one drying station comprises a first oven operable to partially dry the sprayed, impregnated web, the apparatus further including:

a coating station placed after said at least one drying station and operable to coat said partially dried, sprayed, impregnated web with a coating of thermosetting resin; and

a second drying station placed after said coating station and before said cutting station for completing the drying of the web.

7. A top sheet for use in a thermosetting resin impregnated laminate, comprising:

a paper web impregnated with a thermosetting resin selected from the group consisting of melamine-formaldehyde, phenol-formaldehyde, phenol-urea-formaldehyde, melamine-urea-formaldehyde, urea-formaldehyde and polyester, and having a resin content between 30 and 80 percent by weight, said paper web having an upper surface; and

a layer of abrasion-resistant particles sprayed onto said upper surface at a concentration of 1 to 40 grams per square meter prior to drying of the thermosetting resin, said particles having a size falling within a Gaussian distribution centered around nine microns, said particles selected from the group consisting of alumina, silica, silicon carbide, boron nitride, diamond and mixtures of the foregoing.

8. The top sheet of Claim 7, wherein said particles are applied in a slurry having no constituent capable of acting as a binding material.

9. The top sheet of Claim 8, wherein said slurry contains an amount of binder in a ratio by weight relative to said particles ranging from 1:5 to 1:15.

10. The top sheet of Claim 7, wherein said top sheet exhibits a pearlescent or opalescent visual effect.

11. The top sheet of Claim 7, and further comprising a coating of thermosetting resin applied to said layer of abrasion-resistant particles.

12. A method for manufacturing abrasion-resistant surface sheets for laminates, comprising the steps of:

providing a paper web;

impregnating the web with a thermosetting resin;

prior to drying the impregnated web, spraying the impregnated web with a slurry including abrasion-resistant materials;

drying the impregnated web; and

cutting the web into sheets of predetermined length.

13. The method of Claim 12, wherein said step of spraying the impregnated web includes the further steps of:

providing a rotary head disposed above the impregnated web;

affixing a preselected number of spray arms each so as to radially and downwardly extend from the rotary head;

mounting a spray pistol on an end of each spray arm remote from the rotary head;

for each spray pistol, connecting a pressurized air pipeline and a slurry pipeline between the pistol and respective sources of pressurized air and slurry; and

rotating the rotary head while spraying the impregnated web to provide uniform coverage of abrasion-resistant materials on the web.

14. The method of Claim 13, and further comprising the step of adjusting the radial distance of the spray pistol from the axis of the rotary
head as a function of web width.

15. The method of Claim 13, and further comprising the step of adjusting the distance between each spray pistol and the web.

16. The method of Claim 12, and further comprising the step of supplying a source of pressurized slurry through a first pipeline to at least one spray pistol;

supplying pressurized air through a second pipeline to the spray pistol;

mixing the pressurized air and the slurry in the spray pistol; and

spraying the slurry mixture onto the web using the pressurized air.

17. The method of Claim 12, and further comprising the steps of:

after said step of spraying, partially drying the impregnated web;

subjecting the web to a further impregnation of thermosetting resin after said step of partially drying; and

completing the drying of the impregnated web.

18. The method of Claim 12, and further comprising the step of formulating the slurry to contain essentially no binder material.

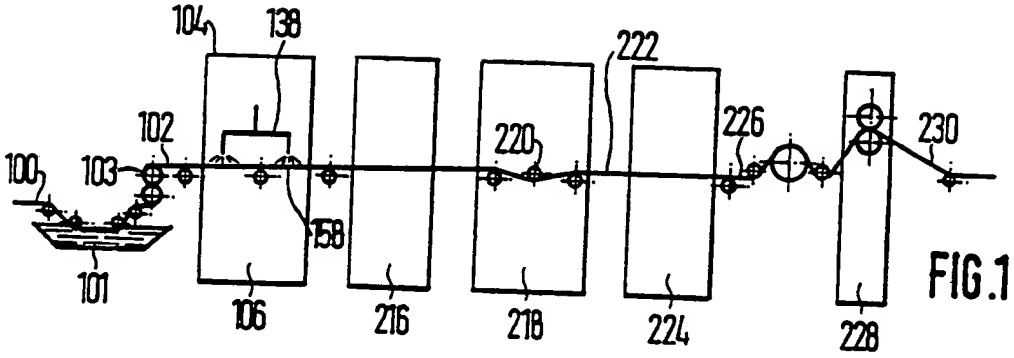
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FIG.1

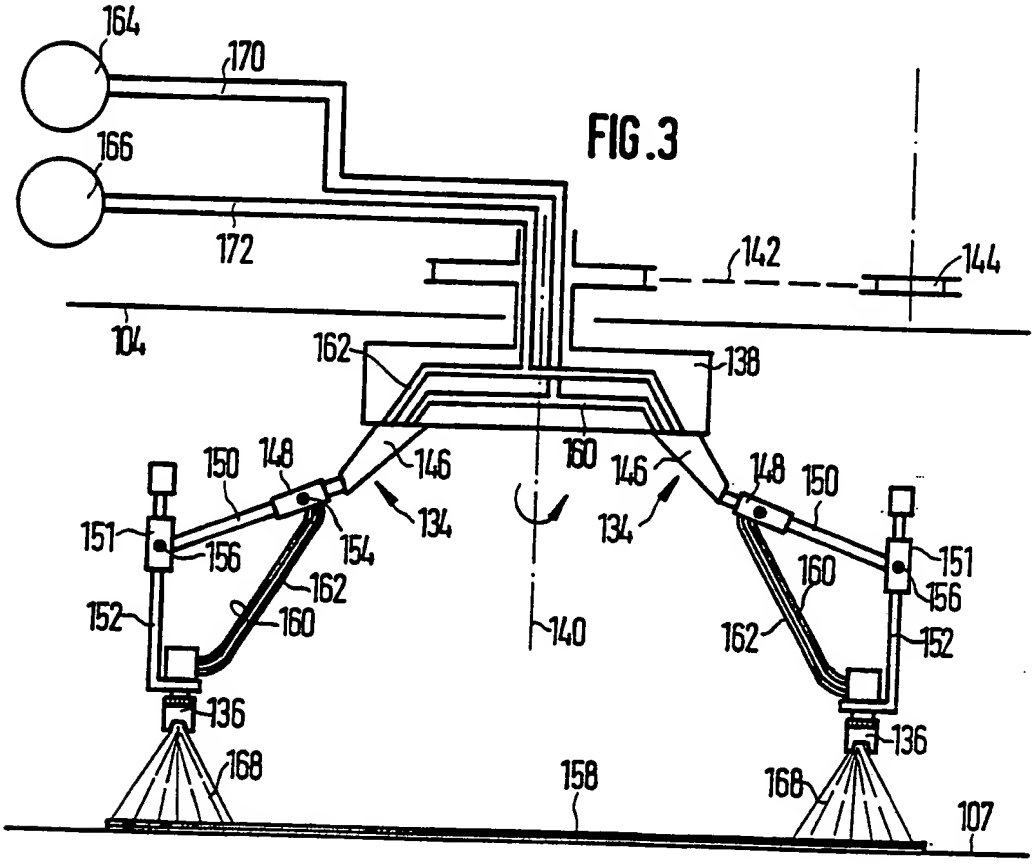
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FIG.3

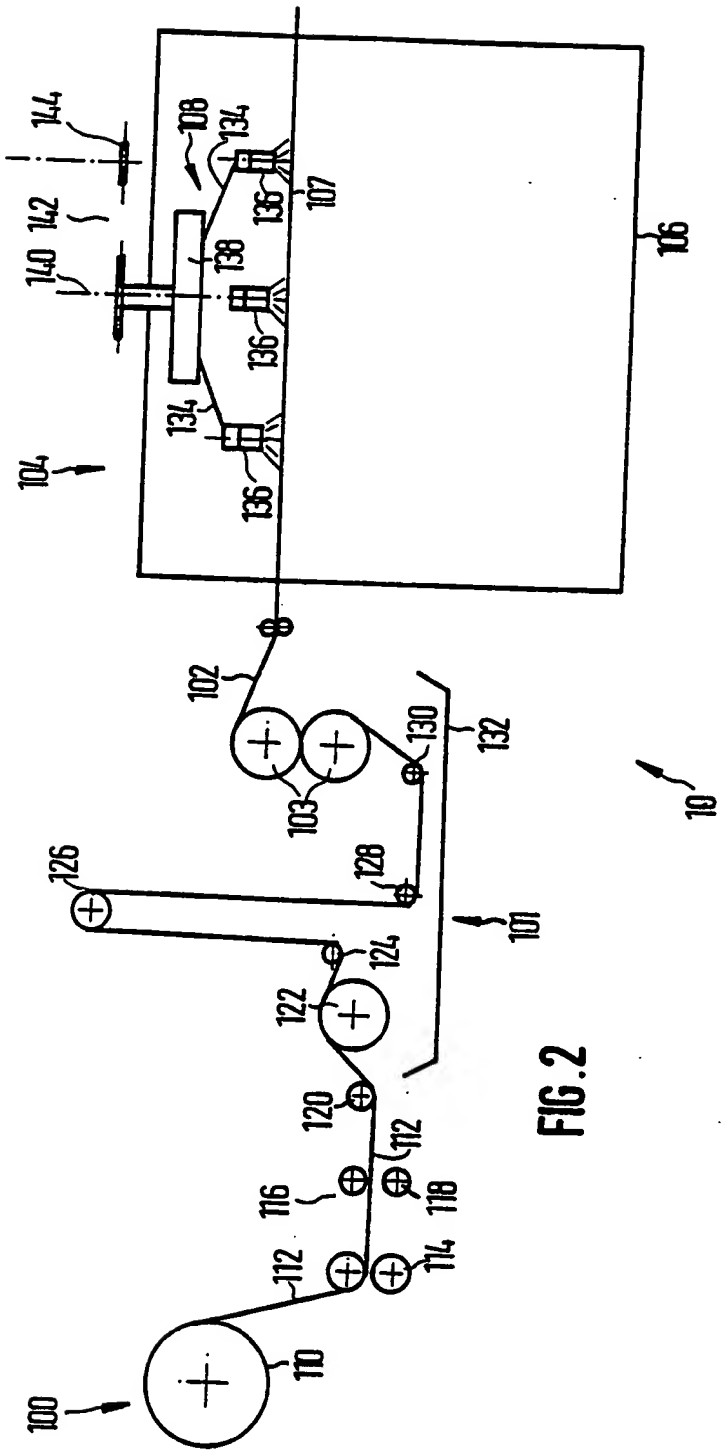
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FIG.2

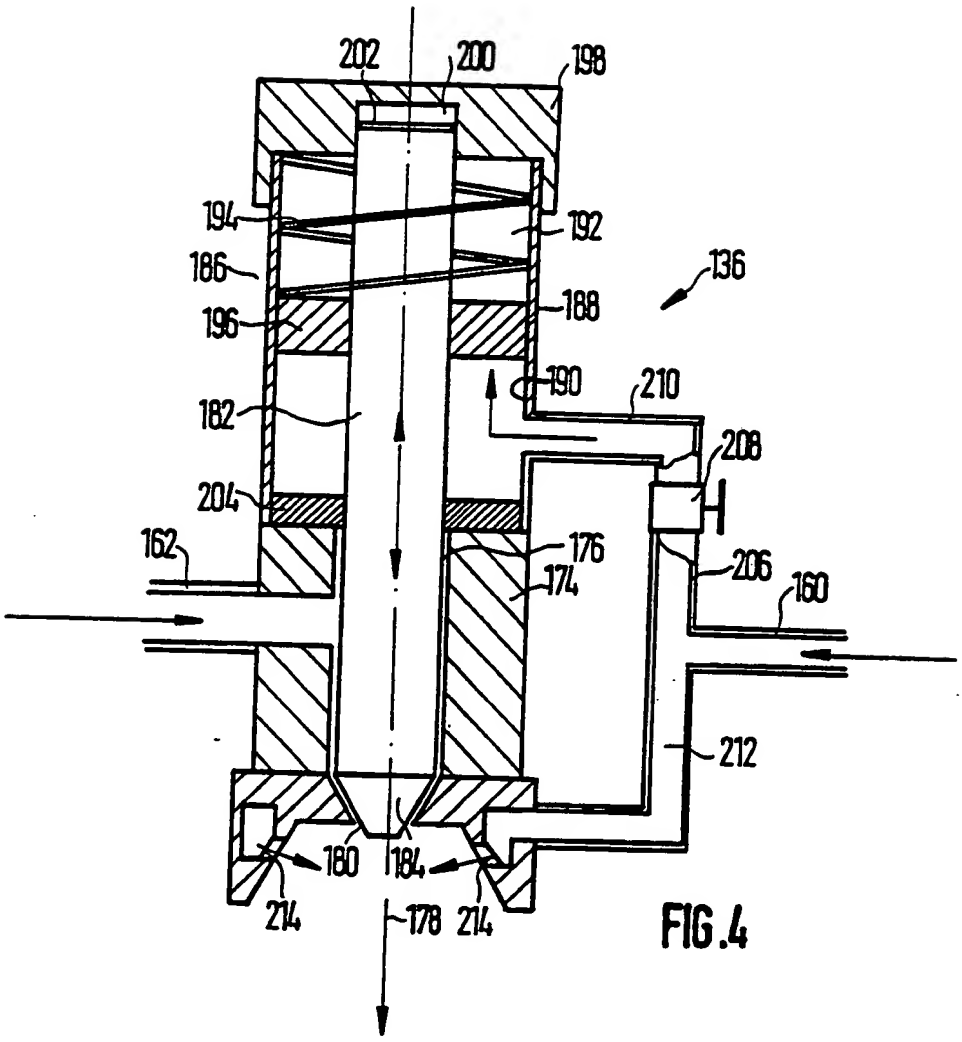
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FIG.4

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 D21H23/50; D21H27/28; B05B13/04

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	D21H ; B05B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	US,A,4 151 808 (BECK ET AL.) 1 May 1979 see column 1, line 65 - column 5, line 22	1
A	US,A,3 525 664 (HALE) 25 August 1970 see the whole document	1,4,7,12
A	US,A,4 940 503 (LINDGREN ET AL.) 10 July 1990 cited in the application see the whole document	7,12
A	US,A,4 505 974 (HOSLER) 19 March 1985 cited in the application see column 3, line 46 - line 68	1,7

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
21 JUNE 1993	01 07 93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	VAN BEURDEN-HOPKINS

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

EP 9300456
SA 71291

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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